



# mycology world

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# MYCOLOGY

**MYCO = FUNGUS**

**OLOGY = SCIENCE or STUDY**

**Mycology is the study of fungi ..or it is a  
branch of biological science dealing with  
the study of fungi**

# WHAT ARE THE FUNGI?

Fungi are not plants.

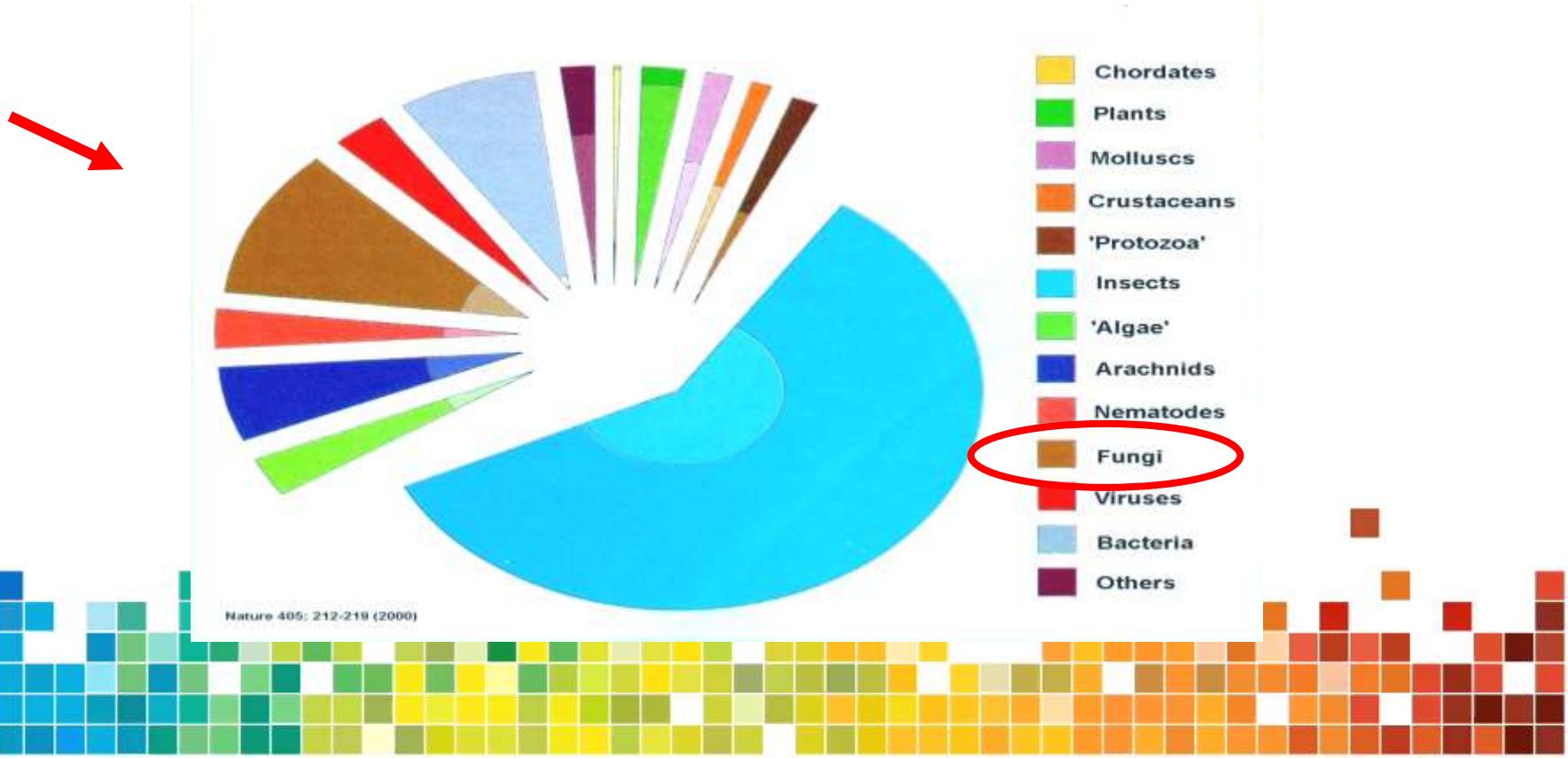
Fungi form a separate group of higher organisms, distinct from both plants and



animals



# THE CREATURES





# GENERAL CHARACTER OF FUNGI

## Fungi:

Are Eukaryotic microorganisms have a nucleus, their organelles may or may not have a membrane, and they reproduce asexually or sexually.

# FUNGI GENERAL CHARACTERISTIC

Fungi are **heterotrophic** ("other feeding" must feed on preformed organic material), not **autotrophic** ("self feeding", make their own food by **photosynthesis**) Relatively simple nutritional requirements

# FUNGI GENERAL CHARACTERISTIC

Fungi obtain their nourishment by secreting enzymes for external digestion and by absorbing the nutrients that are released from the medium

# FUNGI GENERAL CHARACTERISTIC

Fungi range in form and size from **unicellular yeasts** to large **multicellular mushrooms** and **puffballs**.

**Non-motile eukaryotes lacking chlorophyll**

Contain **nucleus**, **mitochondria**, **80S ribosomes**

# FUNGI GENERAL CHARACTERISTIC

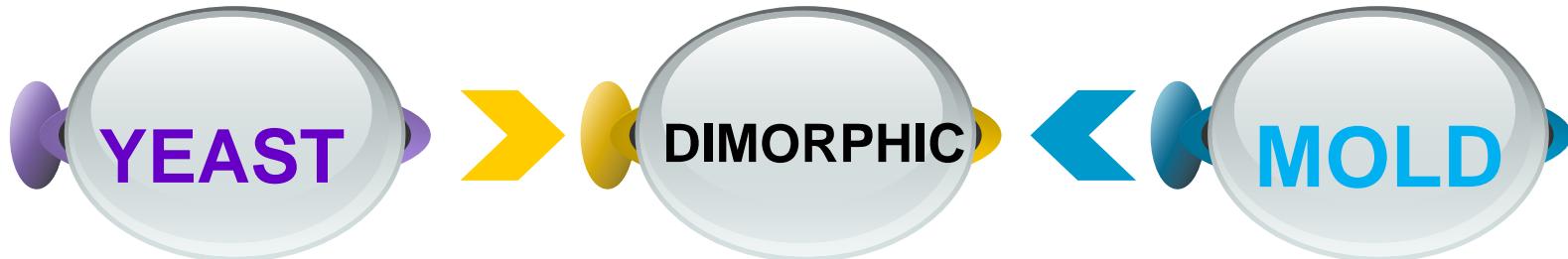
**Cell wall is similar to plant cell wall but it composed of chitin and various glucans, mannans, and complex polysaccharides (plant cell wall cellulose)**

# FUNGI GENERAL CHARACTERISTIC

Most fungi store their food as **glycogen** (like animals); plants store food as **starch**

Fungal **cell membranes** have a **unique sterol**, **ergosterol**, which replaces **cholesterol** found in mammalian cell membranes

# FUNGI GENERAL CHARACTERISTIC



**UNICELLULAR**

**ROUND-OVAL**

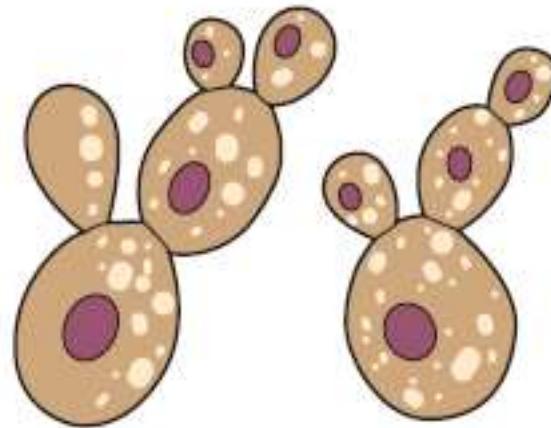
**BUDDING**

**MULTICELLULAR**

**FILAMENTUS-TUBE**

**HYPHAE-MYCELIA**

# FUNGI MORPHOLOGICAL FORMS



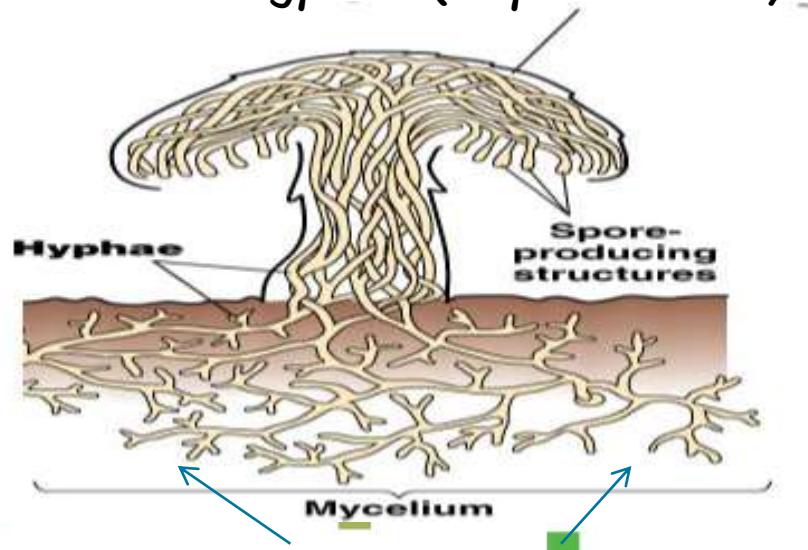
*Budding yeast*



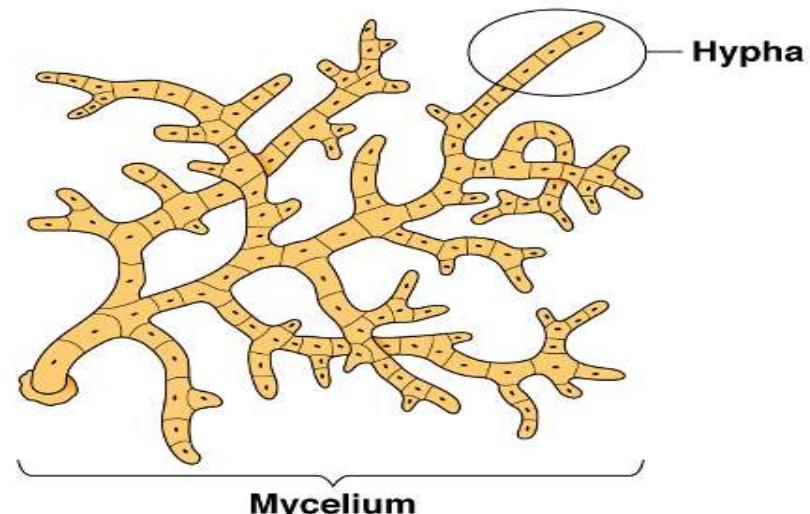
*Pseudohyphae*

# FUNGI MORPHOLOGICAL FORMS

Aerial hyphae (Reproductive)

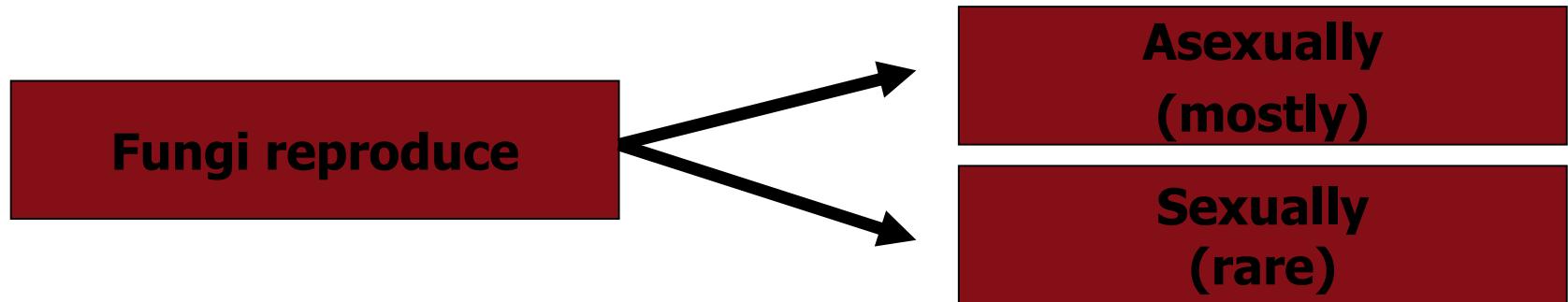


Rhizoidal hyphae (Vegetative)



Dr. Mahmoud ElHariri

# Fungi reproductive classification



- Reproduce by means of spores (usually wind-disseminated)

# Fungi reproductive classification

## Anamorph= asexual stage

spore formed via asexual reproduction (mitosis), commonly called a conidium or sporangiospore

## Teleomorph= sexual stage

spore formed via sexual reproduction (meiosis),

- type of spore varies by phylum

# Nutritional Status of Fungi

■ **Saprophytes**

■ **Parasites**

■ **Mutualists (symbionts)**

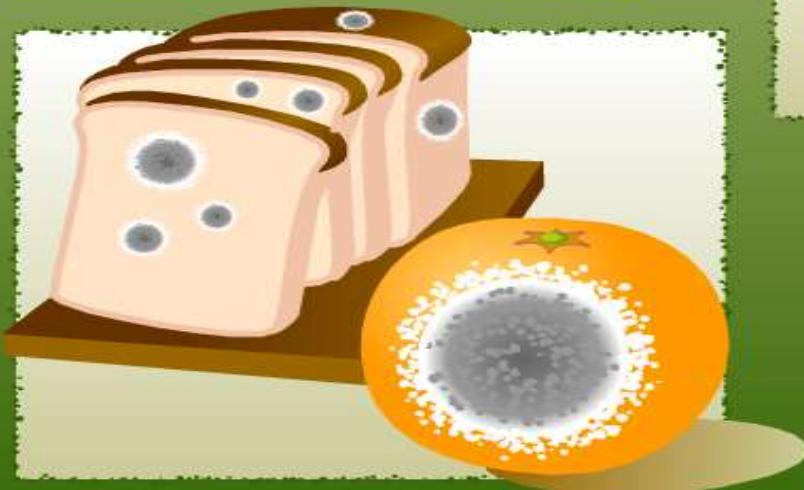
# Saprophytes

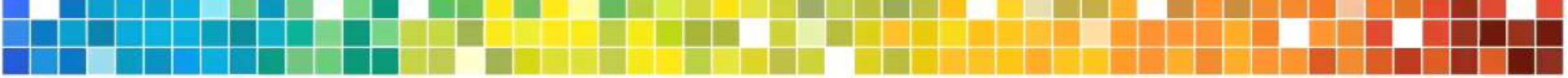
- Use non-living organic material.
- Along with bacteria, fungi are important in recycling carbon, nitrogen, and essential mineral nutrients.

## Many fungi are saprobes.

### Saprobe:

An organism that obtains carbon and energy from dead organic matter







1/12/2000 12:32pm

# Decomposers

As saprotrophs, particularly as decomposers, fungi are essential components of the carbon cycle and are among the few organisms that can break down lignin

# Parasites

- Use organic material from living organisms, harming them in some way
- Range of hosts: plants – animals – humans

## Some fungi are parasites.

### Parasite:

An organism that benefits from its close association with an organism of another species (the host); the benefit is at the expense of the host

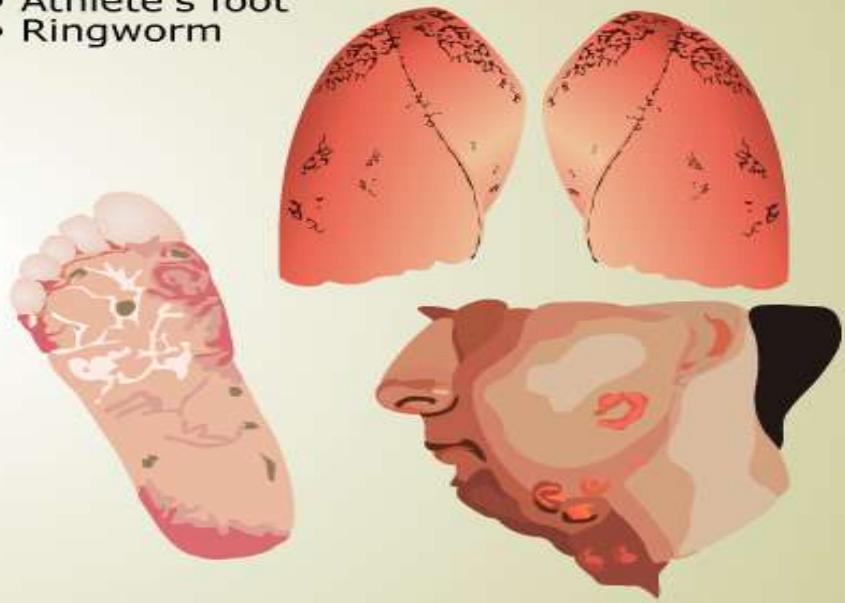
Parasitic fungi cause plant diseases:

- Dutch elm disease
- Chestnut blight
- Various rusts, smuts, scabs, rots, and wilts



Parasitic fungi cause human diseases:

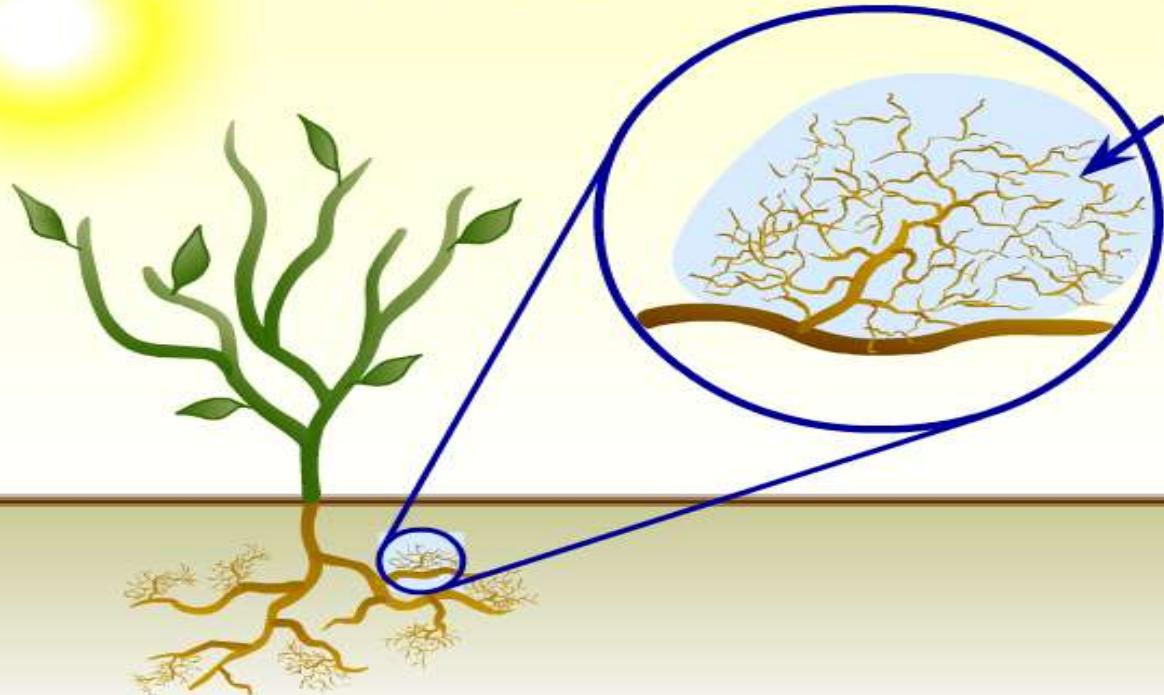
- Histoplasmosis
- *Pneumocystis pneumonia*
- Athlete's foot
- Ringworm



# Mutualists (Symbionts)

- Fungi that have a beneficial relationship with other living organisms.
- Mycorrhizae: associations of fungi with plants' roots.
- Lichens: associations of fungi with algae or cyanobacteria

## Many fungi are symbionts.



### **Mycorrhiza:**

The symbiotic association of the root of a plant with the mycelium of a fungus

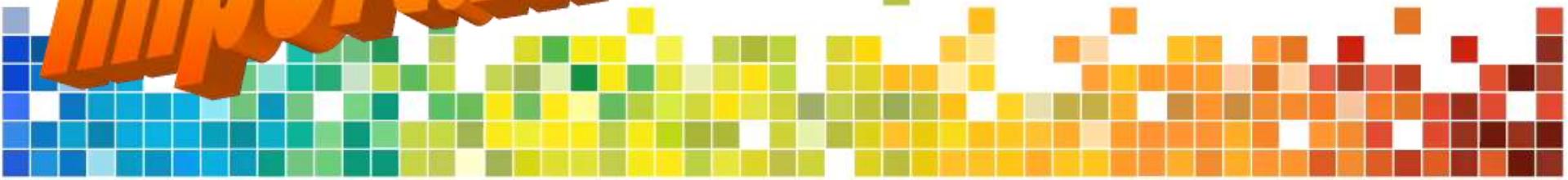
### **Symbiont:**

An organism that lives in a symbiotic relationship with another organism

### **Symbiosis:**

The living together of two dissimilar organisms in close association

# *Importance of Fungi*



# Fungal Species

**>250,000 species, most are saprophytic**

**~500 species, pathogens of humans/animals (0.5%)**

**~8,000 species, plant pathogens (8%)**

**Over 65% of plant diseases are caused by fungi**

# Fungi .. Harmful to Human Interests

Can cause human disease, either directly or through their toxins.

- Can cause diseases of plants and animals that humans are interested in (*e.g. Crops .. etc.*).
- Cause rot and contamination of foods.
- Can destroy almost every kind of manufactured good – with the exception of plastics and some pesticides.

# Fungi .. Useful to Human Interests

- Yeasts: baking and brewing



- Antibiotics (penicillin and cephalosporin)



- Other drugs (cyclosporin)

- Many organic acids are commercially produced with fungi; Citric acid in Coke is produced by an Aspergillus.



- Steroids and hormones (the pill).

- "Stinky" cheeses (Roquefort and Camembert).

# Fungi Morphological Classification

Yeast

Filamentous  
fungi (molds)

Dimorphic

# Fungi Morphological Classification

Yeast

Filamentous  
fungi (molds)

Dimorphic

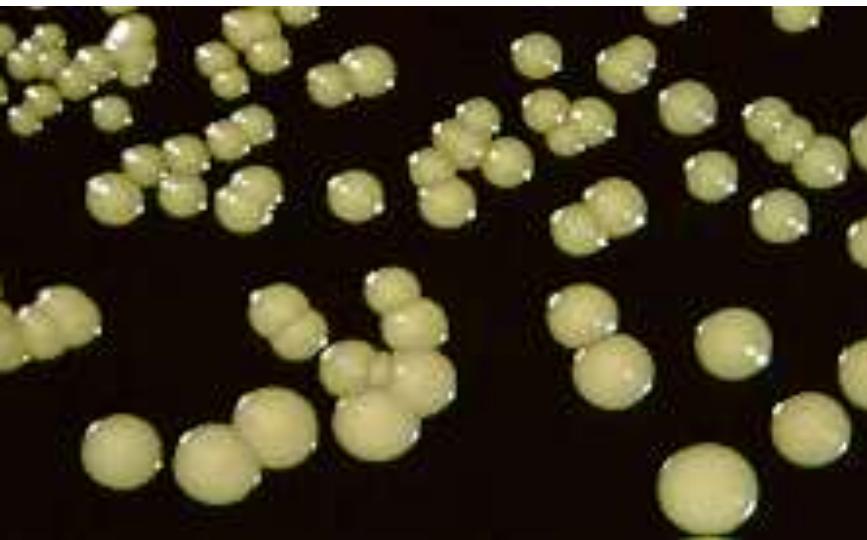
The basic element of the unicellular fungi.

It is **round** to **oval** and 3 –10  $\mu\text{m}$  diameter.

Single cells, reproduce by budding

separate : *Cryptococcus neoformans*

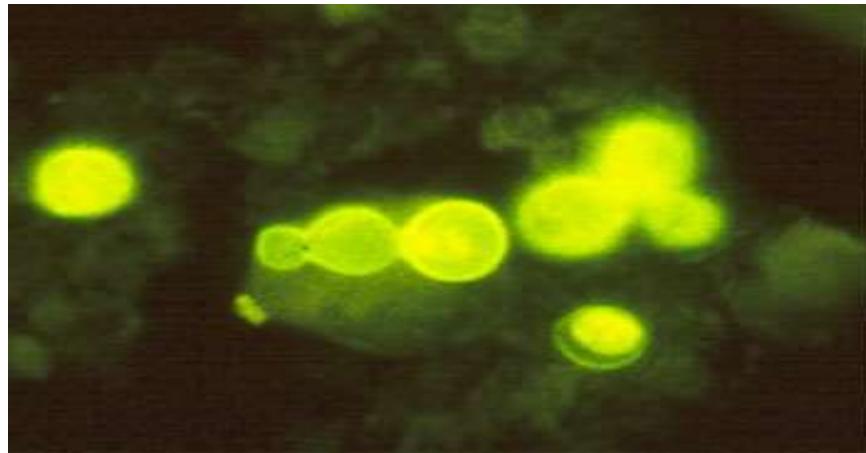
attached : *Candida albicans*



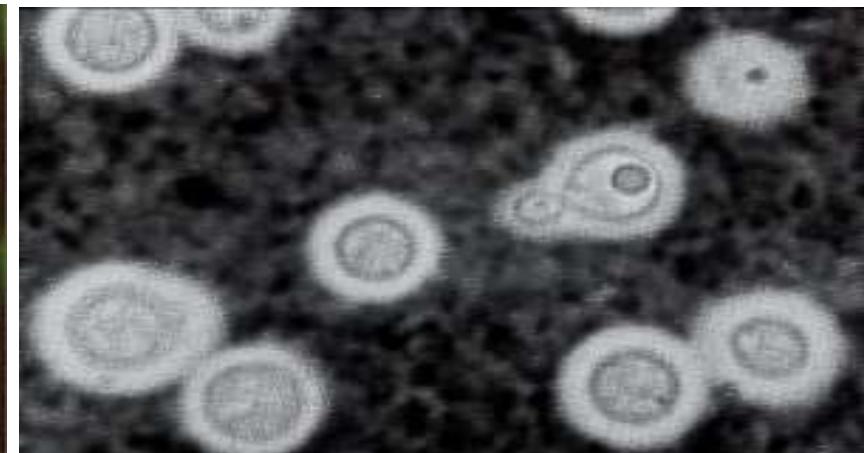
*C. albicans*  
white colonies  
on SDA.



*Geotrichum*  
white wrinkled  
colonies on SDA.



Attached  
budding yeast



Separated  
budding yeast

# Fungi Morphological Classification

Yeast

Filamentous  
fungi (molds)

Dimorphic

Grow as threads (hyphae) Interlace to form mycelium

Septated non colored hyphae :

*Aspergillus spp, Dermatophytes, Penicillium spp, Fusarium spp*

Colored hyphae (Dematiaceous fungi):

*Alternaria, Phialophora*

# Fungi Morphological Classification

## Morphology terms:

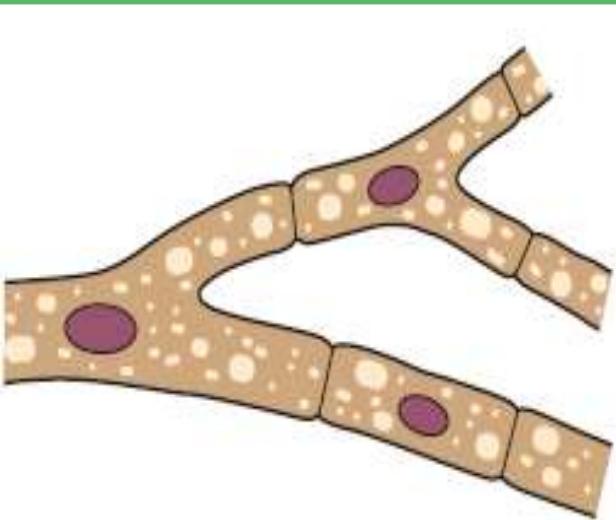
### **Hypha:**

is the basic element of filamentous fungi with a branched, tubular structure, 2–10 µm in width.

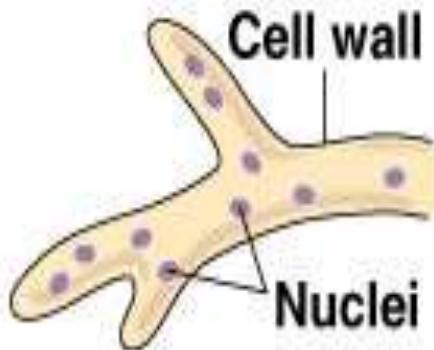
### **Mycelium:**

is the web or matlike structure of hyphae. **Substrate mycelia** (specialized for nutrition) penetrate into the nutrient substrate, whereas

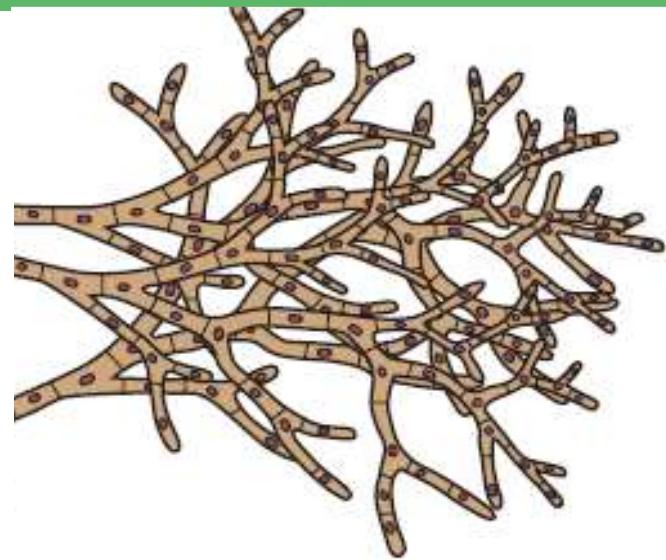
- **aerial mycelia** (for asexual propagation) develop above the nutrient medium.



Septated  
Hyphae



Aseptated  
Hyphae  
(coenocytic)



Branched  
hyphae web  
(Mycelium)

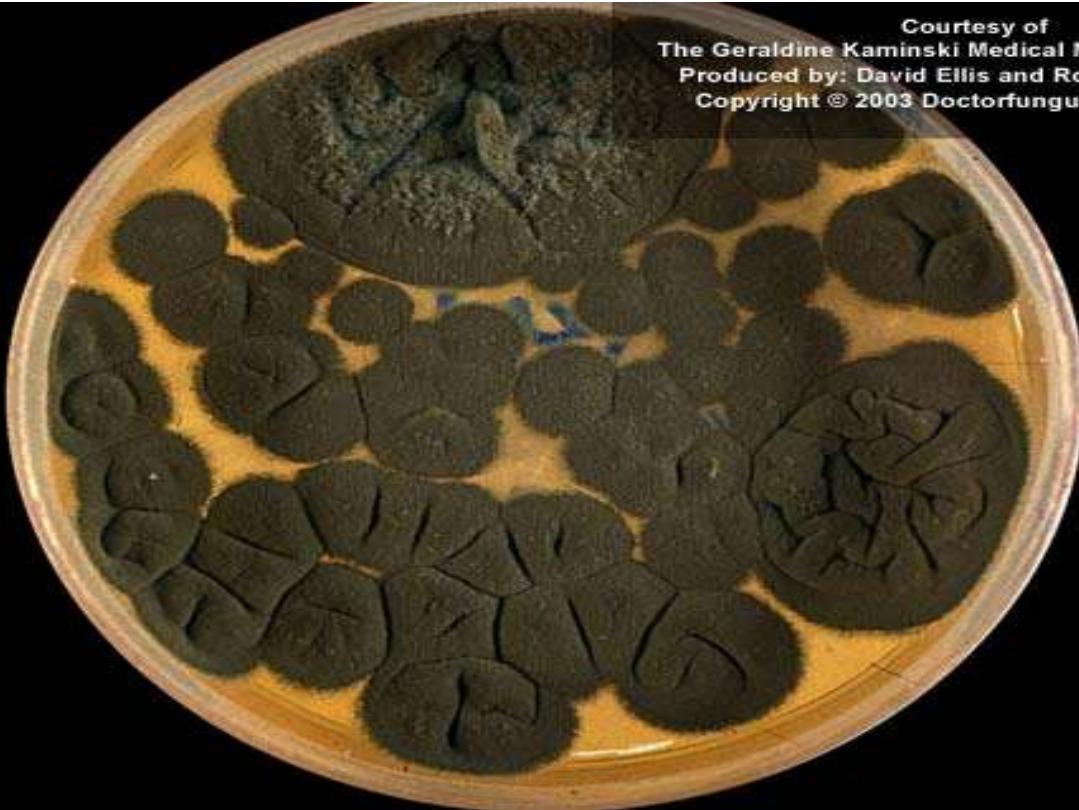


**Aspergillus  
fumigatus**



**Air sacs of a hen  
during epidemic  
aspergillosis**

Courtesy of  
The Geraldine Kaminski Medical Mycology Library  
Produced by: David Ellis and Roland Hermanis  
Copyright © 2003 Doctorfungus Corporation



*Penicillium* species

# Fungi Morphological Classification

Yeast

Filamentous  
fungi (molds)

Dimorphic

Single cells, reproduce by budding exist in two forms

(*Histoplasma capsulatum* , *Blastomyces dermatitidis*)

Yeast (at 37 °C)

Or

Mold (at 27 °C)

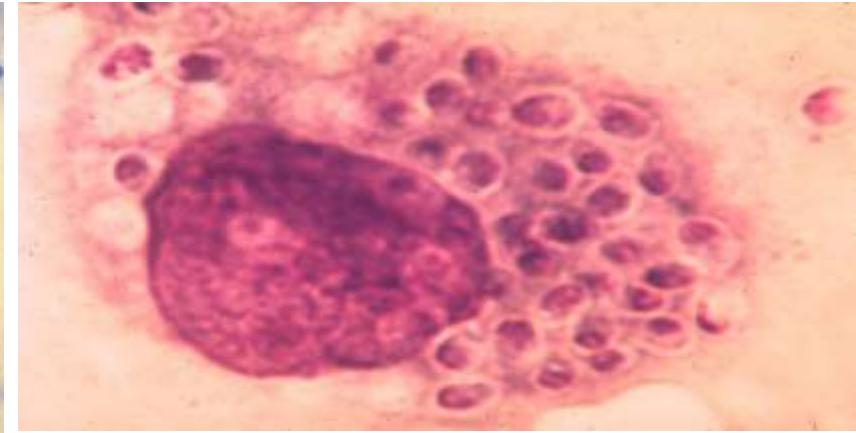
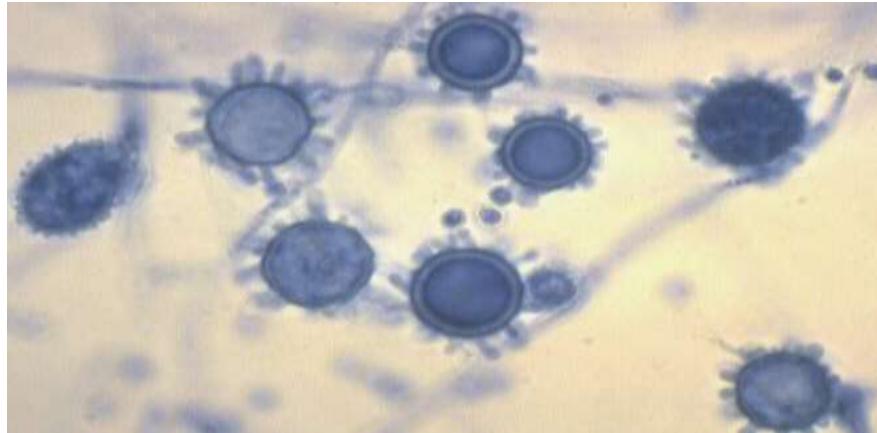
# Fungi Morphological Classification

## Morphology terms:

### **Dimorphism:**

some fungal species can develop either the **yeast** or the **mycelium** form depending on the environmental conditions, a property called dimorphism.

Dimorphic pathogenic fungi take the form of **yeast** cells in the **parasitic stage** and appear as **mycelia** in the **saprophytic stage**.



**Hyphael phase  
(Saprophytic)**

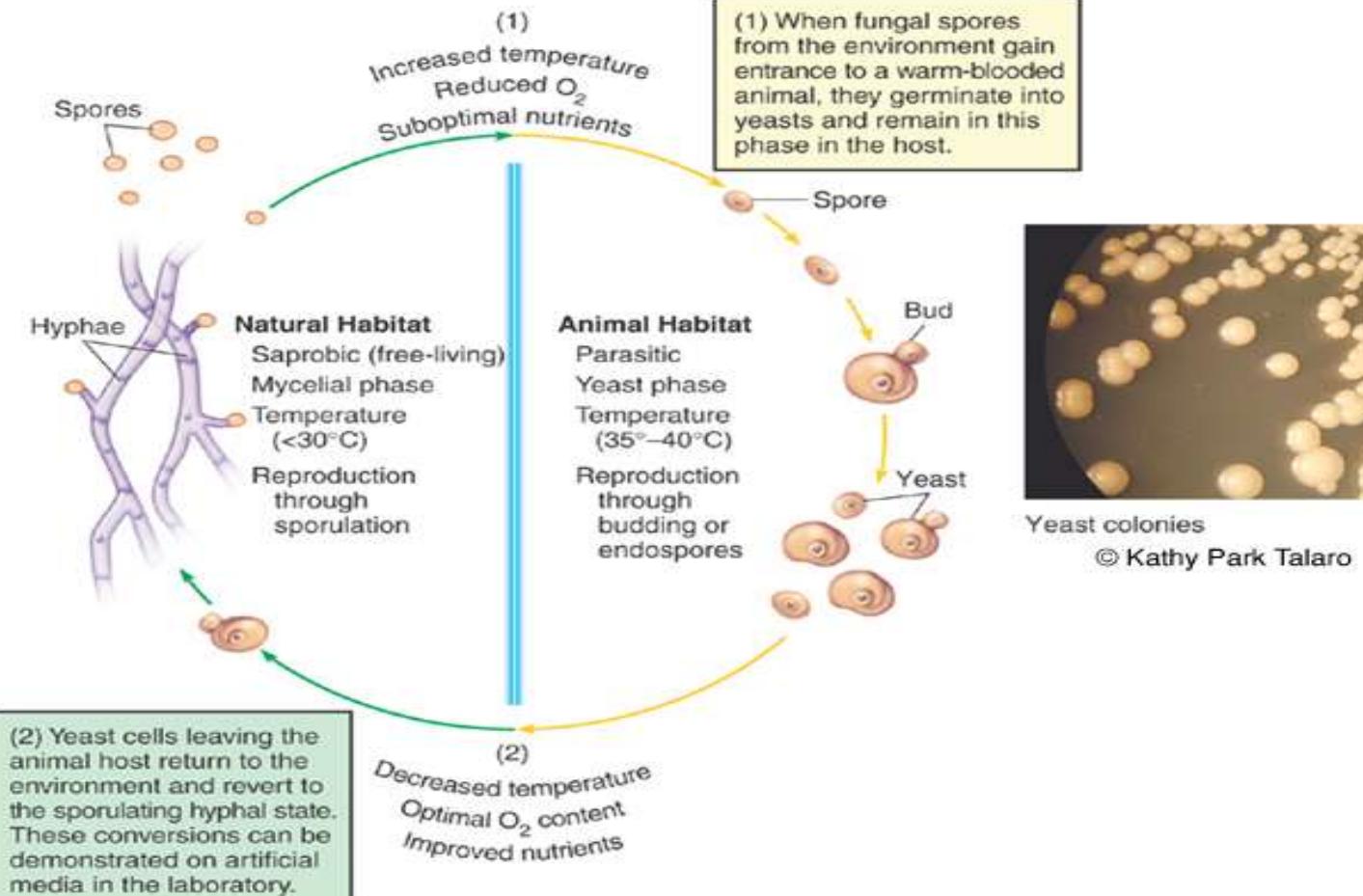
**Yeast phase  
(Parasitic)**

# THERMAL DIMORPHISM

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Hyphal colonies  
© Kathy Park Talaro



# Fungi reproductive classification

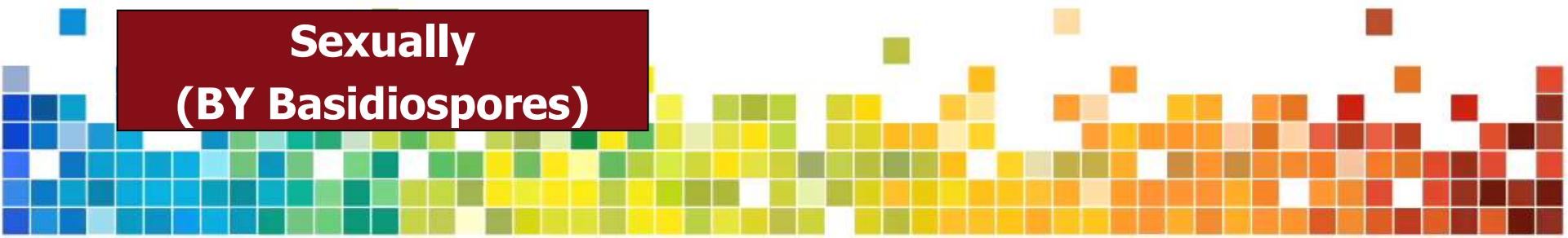
**Sexually  
(rare)**

**Asexually  
(mostly)**

**Sexually  
(BY Zygospores)**

**Sexually  
(BY Ascospores)**

**Sexually  
(BY Basidiospores)**



# ASEXUAL REPRODUCTION (ANAMORPH)

*Asexual spores are:*

*conidia*

Blasto...

Phialo..

Chlamydo..

Arthro...

*Sporangio  
spores*

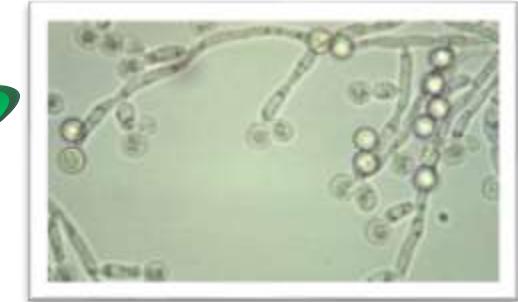
**BLASTO**



**PHIALO**



**CHLAMYDO**



**ARTHRO**

**Asexual  
Conidia**



# BLASTOCONJDJA:

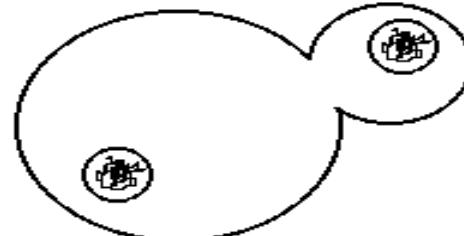
Asexual reproduction by budding as in yeasts

- Offspring grows out of parent
- Fast, somewhat simple
- Same DNA

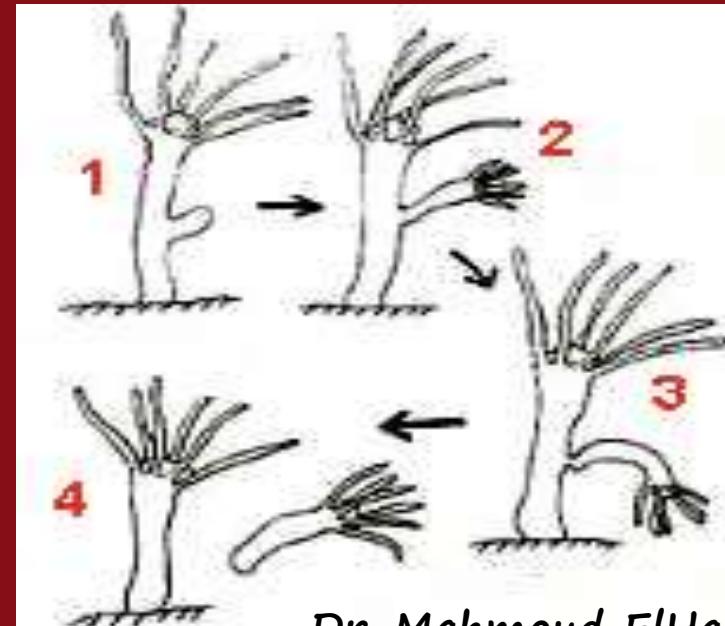
Replicating Yeasts: Fission vs. Budding



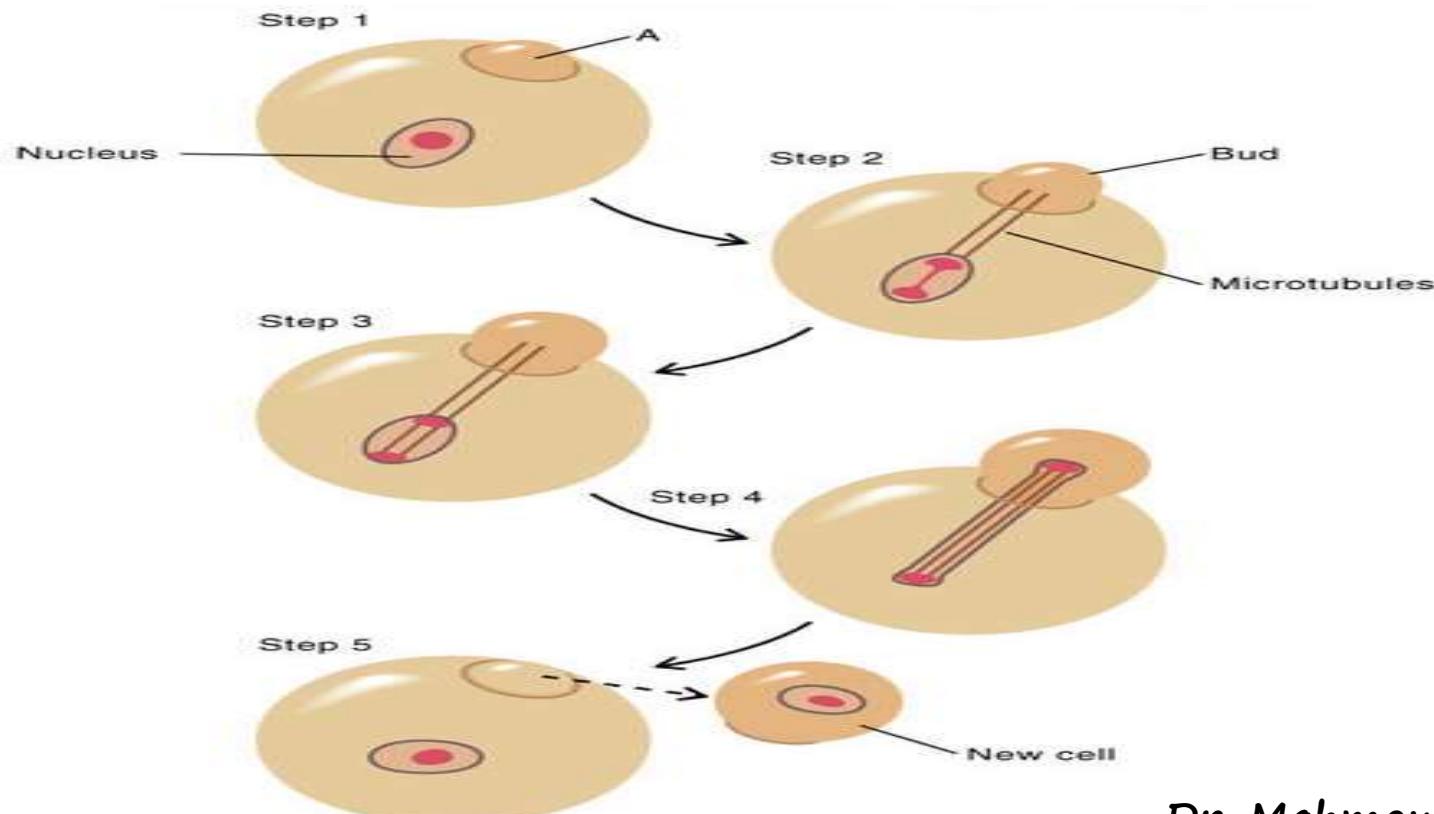
yeasts undergoing fission  
*Schizosaccharomyces* spp.



budding yeasts  
*Saccharomyces* spp.



# BLASTOCONJDJA:



# BLASTOSPORE (BUDDING)

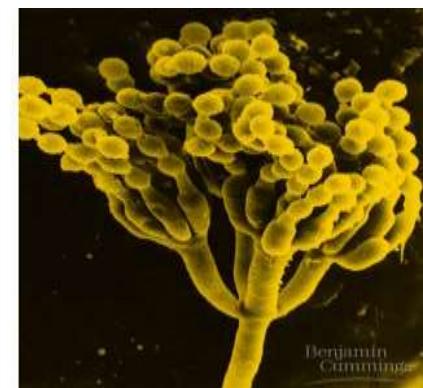
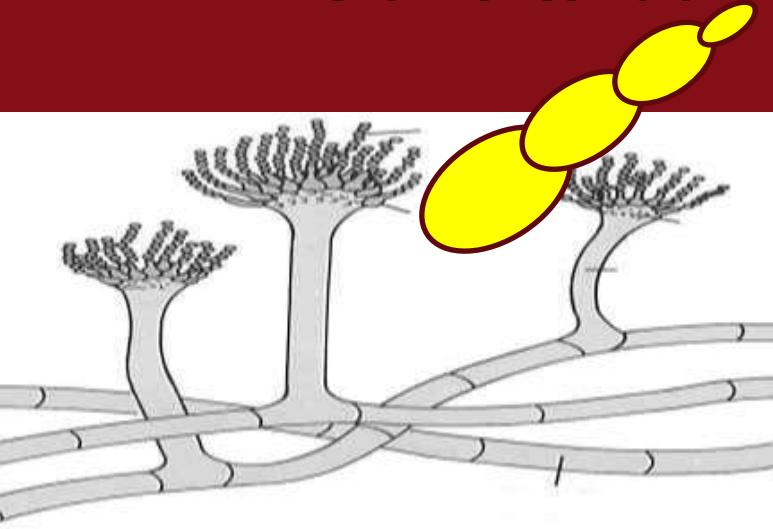


Asexual  
Conidia

# **PHIALEOCONDIA:**

By formation of flask shaped extension  
(phialids) as in *Aspergillus*, *Penicillium*

**Chain of conidia**



# PHIALOSPORE

Asexual  
Conidia



# ***CHLAMYDOSPOONJDJA:***

By formation of hyphal cell with thick wall which  
may terminal, lateral as *Candida albicans*



## ***ARTHRODIOCONJDJA:***

By formation of fragmentation of septated hypha into the individual cell as *Geotrichum candidum*



# ARTHROSPORE

Asexual  
Conidia



## ***SPORANGIOSPORES:***

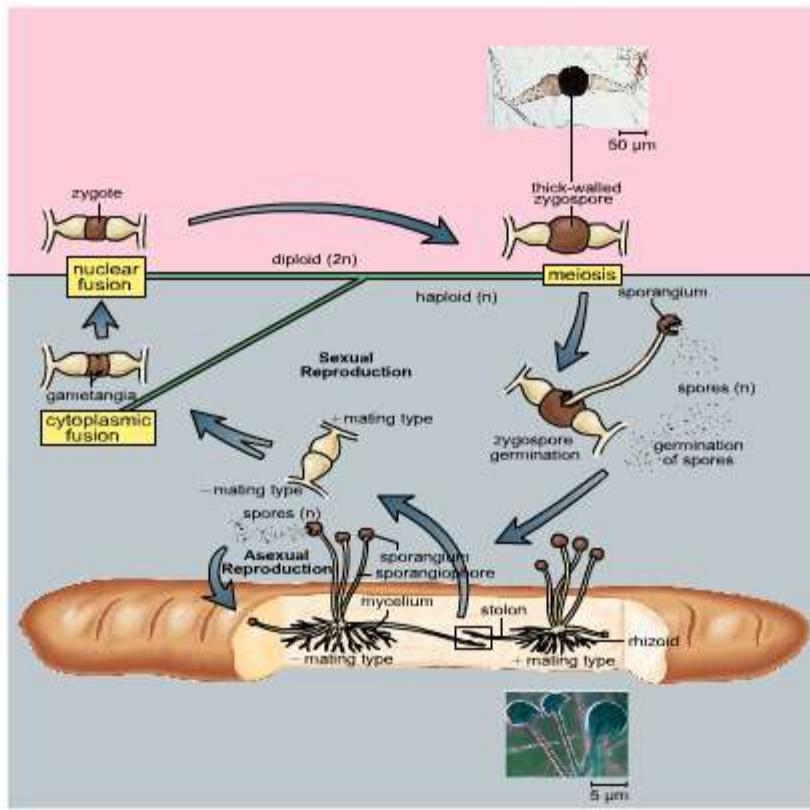
may be delimited within a sac-like structure, a sporangium (plural: sporangia), in which case they are called **sporangiospores**, borne on a **sporangiophore** only

In aseptated fungi

(Mucor)



Dr. Mahmoud E/Hariri



**Figure 31.03**  
Black bread mold, *Rhizopus stolonifer*.



# Fungi reproductive classification

**Sexually  
(rare)**

**Asexually  
(mostly)**

**Sexually  
(BY Zygospores)**

**Sexually  
(BY Ascospores)**

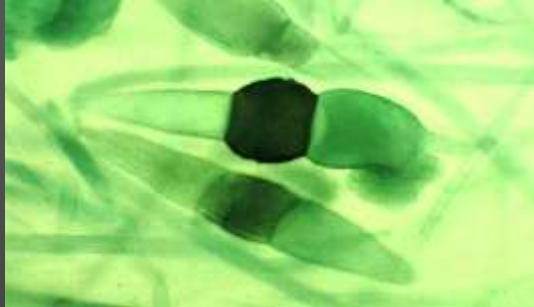
**Sexually  
(BY Basidiospores)**



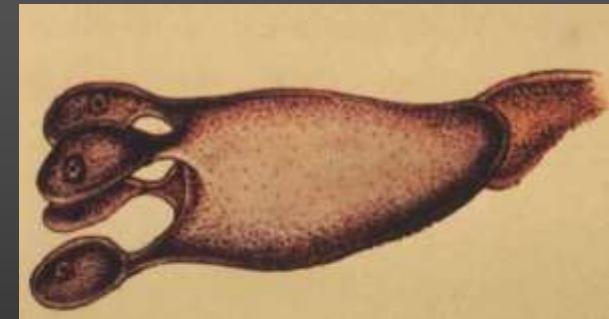
# WE HAVE THREE TYPES OF SEXUAL SPORES



Ascospores



Zygospore



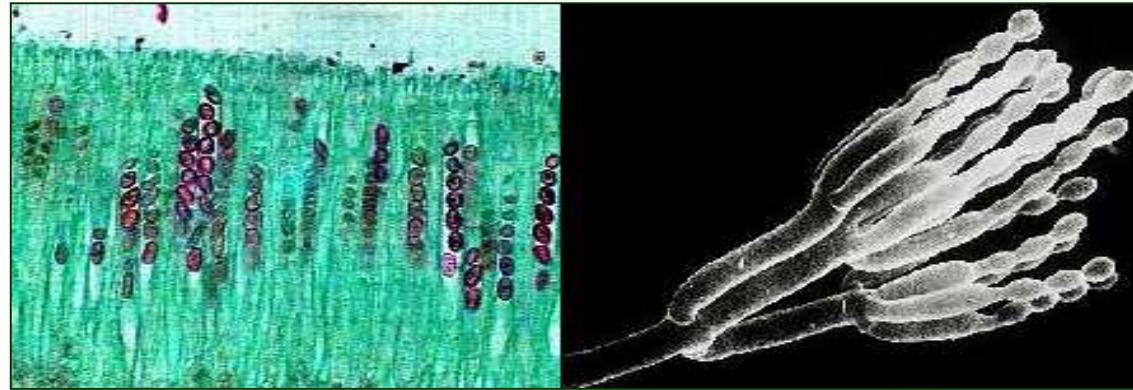
Basidiospores

# Sexual Reproduction (Teleomorph)

- Sexual reproduction involves the union of two haploid mating type (plus) "+" and (minus) "-".
- Hyphae of opposite mating types meet and fuse, bringing "+" and "-" nuclei together in one diploid cell .

# Ascospores

- Sexual spores borne internally in a sac called ascus
- Asexual spores are borne externally as conidia



This phylum includes cup fungi, morels and most of the yeasts. Most crop plant pathogens belong in this phylum. When an asexual state is formed by these fungi they are usually externally borne spores called conidia.

# **Fungi Kingdom**

**Phylum Ascomycota**

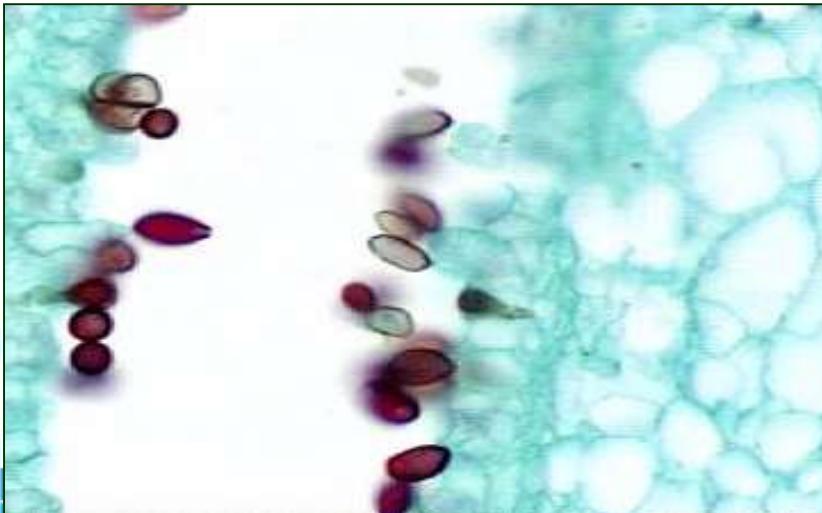
**Phylum Basidiomycota**

**Phylum Zygomycota**



# Basidiospores

- Sexual spores borne externally on a club-shaped structure called basidium
- Usually no asexual spores



*This phylum includes familiar mushrooms, puffballs, and shelf fungi, along with the less familiar rusts and smuts. The basidia usually line up next to one another and form a hymenium.*

# Basidiospores: produced on basidium (mushrooms)

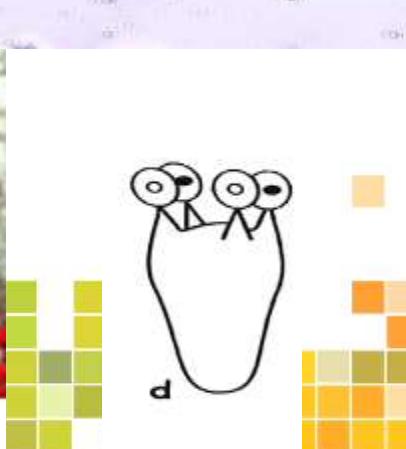
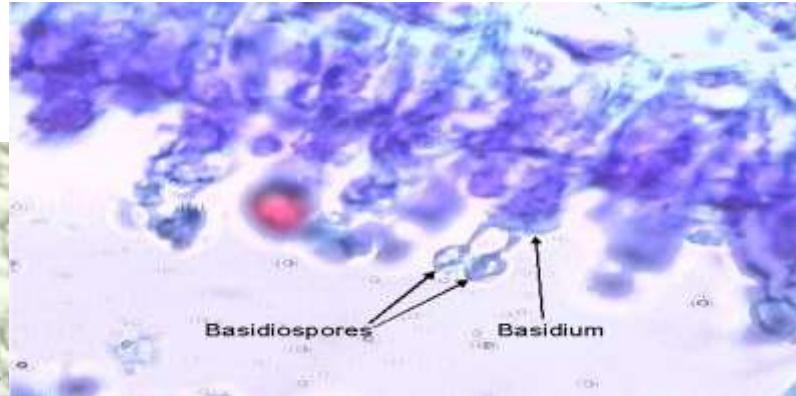
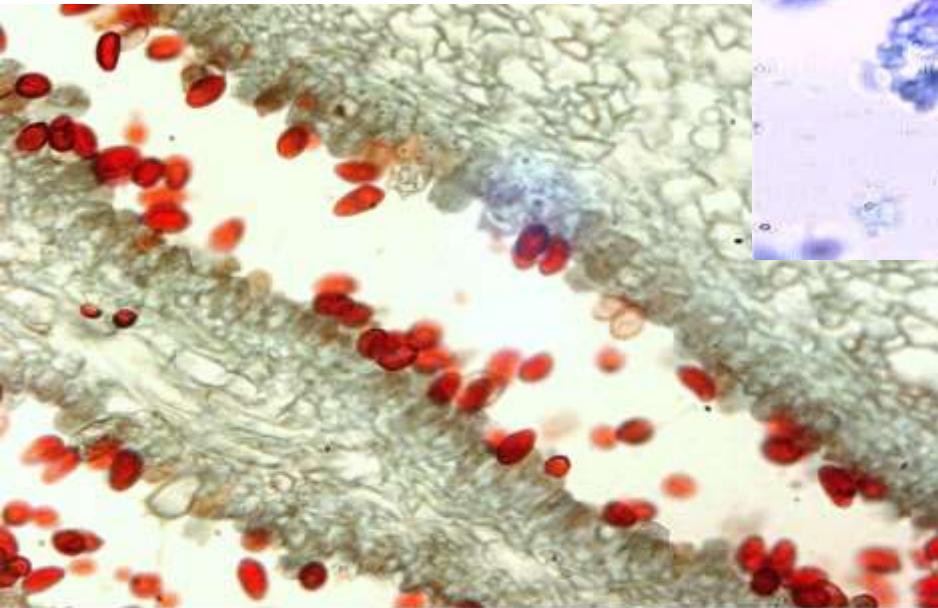
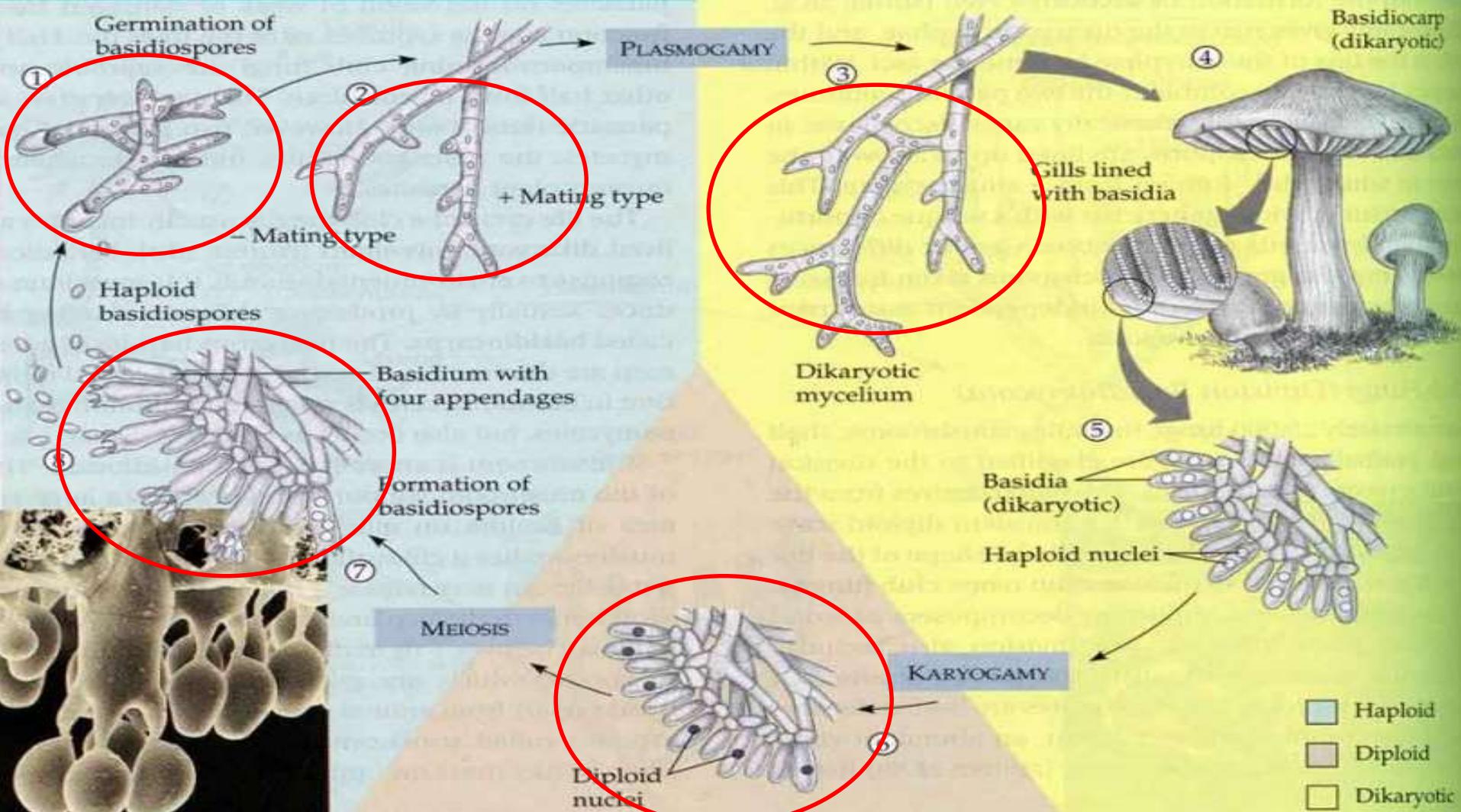


Figure 30 Basidia and basidiospore



# **Fungi Kingdom**

**Phylum Ascomycota**

**Phylum Basidiomycota**

**Phylum Zygomycota**



# **Fungi Kingdom**

**Phylum Ascomycota**

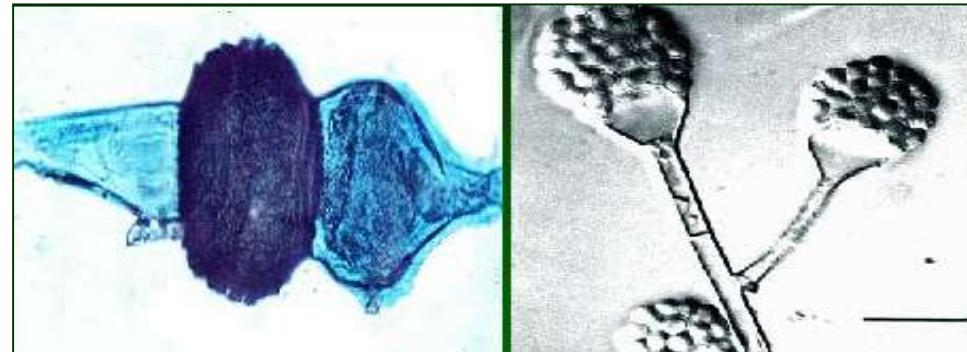
**Phylum Basidiomycota**

**Phylum Zygomycota**



# Zygosporangia

- Sexual spores are thick walled resting spores called zygosporangia
- Asexual spores are borne internally in a sporangium



*These are commonly called the bread molds. Most are saprophytic, but there are many that can act as plant and human pathogens.*

# **Fungi Kingdom**

**Phylum Ascomycota**

**Phylum Basidiomycota**

**Phylum Zygomycota**



# Growth of Fungi

## I) Growth Requirements:

Fungi need for their growth:

- A source of Carbon (*eg. CHO*)
- A source of nitrogen (*eg. Peptone*)
- Inorganic compounds (*eg. Ammonium nitrate*)
- Inorganic Nutrients (*eg. K, Ph, Mn*)
- Water (*absolute requirement for fungi*)

# Growth of Fungi

- II) Temperature**
- III) pH**
- IV) O<sub>2</sub> Requirement**
- V) Light**

# Fungal Metabolites (Products)

- 1) Mycotoxins
- 2) Phytoxins
- 3) Antibiotics
- 4) Pigments
- 5) Enzymes
- 6) Plant growth factors



*Thank You*



**Thank You**